Bridges: Wear footbridge

PROBLEM SOLVING

A new footbridge across the River Wear in Sunderland promises to revitalise the city centre by developing the riverside area and boosting connectivity. **Helena Russell** reports.

It has been a long time coming, admits Sunderland City Council contracts manager Chris Ferry. The need for an additional link over the River Wear, whose ravine cuts the city in two, was established more than 20 years ago.

Poor connectivity was identified as one of the key elements hindering the redevelopment of the disused land both at river level and above.

The council launched an ambitious masterplan for Riverside Sunderland in 2019. It proposed to double the number of residents in the city centre to 5,000 by creating 1,000 new homes in four new neighbourhoods and 1M.ft^2 of office and workspace. These new areas would be united with parks and public spaces. With the masterplan straddling the river, two bridges, one high level and one low level, were considered necessary. Community engagement put top priority on the high level link.

Existing pedestrian and cycle access across the river is woefully inadequate, even without the new neighbourhoods.

Walkers and cyclists jostle in shared space on each side of the Wearmouth Bridge, alongside five traffic lanes. When Sunderland Football Club's Stadium of Light hosts big events, some traffic lanes have to be given over to pedestrians to provide enough capacity.

The addition of the 250m long, 10m wide New Wear High-Level Footbridge will certainly unblock this bottleneck, but as Ferry explains, providing such a generous crossing was not based solely on the needs of the stadium.

"The bridge is predominantly for everyday use. It is not just a piece of infrastructure, it is an extension of the public realm, creating a bond between the two sides of the river," he says.

DESIGN OPTIMISATION

Sunderland worked with consultant AtkinsRéalis to develop the reference design for the bridge. Its alignment follows the orientation of the Keel Line, a 292m long public artwork referencing the 8,102 ships built in the city's shipyards on the south end of the bridge.

The width of the bridge was largely dictated by user experience, in particular the fact that it is 30m above ground.

"The bridge is 250m long in order to cross the gorge; you can't get away from the fact that in windy conditions there will be some discomfort, so we needed to make sure that people feel safe. We wanted it to feel like a street crossing the river," Ferry explains.

As far as its form is concerned, there was a deliberate intention to avoid competing with the city's historic bridges.

"It's lean, sleek and lands very lightly on the riverbanks, whereas the existing bridges are industrial, heavy structures," he says.

Mindful of the potential complexity of the structure, Sunderland City Council chose a two stage procurement process.

"We insisted on review stages in the design to make sure that developed proposals were in keeping with our requirements."

VolkerStevin was engaged under a pre-construction services agreement, and its project manager Mike Rimmer says it took around 16 months to move from reference design to detailed design with consultant Arup and Knight Architects.

"The reference design had red lines in terms of the form and function of the bridge – it's a steel box girder bridge with a precast concrete deck. It's supported by north and south abutments and piers on each side of the river, the locations of which were fixed," says Rimmer.

The initial proposal that the deck be fabricated and erected in five separate pieces was revised during this process. By using strand jacking the main span can now be lifted in a single 105m-long unit, reducing the number of deck units to four and barge deliveries from three to two.

"One of the key drivers for the programme was to place the steelwork order," says Arup project manager Rachel Hurdman, "so the bridge deck was a focus of attention early on."

> **"It's lean, sleek and lands very lightly on the riverbanks, whereas the existing bridges are industrial, heavy structures**

Optimising the geometry of the deck led to a 13% reduction in embodied carbon in materials compared with the reference design, Hurdman explains.

However, an element of this saving was offset by changes that had to be made to the south pier foundation design when site investigations revealed that assumptions about an existing retaining wall could not be relied on. The final outcome was a saving of about 5% in the embodied carbon count of materials, over the reference design.

LOCATION CHALLENGES

VolkerStevin was subsequently contracted to build the footbridge for an agreed price of $44M, starting construction in March 2023 and with completion scheduled for 2025.

Project director Mark Denham says that the first few months were taken up largely by temporary works. "There was a lot of material to be removed – clearing the site and bringing in lots of aggregates to form working platforms," he says. Access was a challenge not just for the single-leg reinforced concrete piers but also for the abutments.

Rimmer adds: "All the locations have their difficulties. The south abutment is on top of the cliff, so there was lots of work involved in ensuring the stability of the cliff and establishing access for the SR95 piling rig." With new buildings close to the site, crane movements had to be carefully managed.

At the north pier, the challenge was acute; the only workable solution was to build a temporary elevated framework to support the piling rig some 8m above lower ground level.

Tony Gee & Partners senior engineer Matt Gorvett explains: "The piles were at the bottom of quite a steep slope down to the river. Originally, we expected there to be a stable limestone layer that we could

Conditions at the north pier location meant a temporary platform had to be built to provide access for the piling rig

rely on to reduce the amount of excavation necessary, but as we progressed it became clear there wasn't."

Tony Gee created the platform by adapting two steel girder sections that had previously been used on a temporary works scheme at the Colne Valley High Speed 2 site. By designing new spliced connections and stiffeners they were able to save the project an estimated 45t of steel.

Restrictions on the size of crawler crane that VolkerStevin could get onto the working platform at the north abutment meant that the 55t platform had to be lifted in sections – subsequent disassembly and reassembly of the platform was also necessary to install the remaining six of the 12 piles at this location.

The same girders were reused for the south pier foundations, which are behind a 9m high river wall that site investigations established to be in very poor condition.

"Our methodology had to accommodate the fact that we wouldn't be able to load it at all, either with temporary or permanent works," Rimmer says.

> **"The deck is formed of 91 precast planks, 2.5m long by 10m wide**

"We put temporary foundations and capping beams behind it and installed temporary steelwork cantilevering out at ground level to get the piling rig into position to build the permanent works."

Piling work finished in April and reinforced concrete construction is now underway at both piers and abutments. Ferry reports that the visible progress means locals are now taking a keen interest. Engagement is expected to reach fever pitch at the end of July when deck installation is programmed to begin.

The box girder deck units were fabricated by Victor Buyck at its facility in Belgium and were due to be loaded out at the end of June for delivery to the site in two marine shipments.

In June, the steel subcontractor will build a temporary tower to support the spliced connection between the first two lifts – lengths of 53m and 30m – which form the side span linking the north abutment to the north pier.

While this connection is made permanent, the same barge will return to Belgium and pick up the two remaining deck units.

On site in Sunderland, lifting subcontractor Mammoet will dismantle its 600t capacity crawler crane and relocate it from the north bank to the south bank for the third lift, the 63m long deck section from south abutment to the south pier.

Preparations will then start for the final lift which is for the main span.

"The critical activity of installing permanent bearings and kentledge on the south side section, and permanent bearings on the north side section, as well as setting up strand jacks is expected to take about a week, during which time the barge will be moored up in port," says Rimmer.

Then it will come back to site and moor across the river so that the final 105m long deck unit can be raised in a lifting operation of around eight hours.

The final key operation is to install the deck planks, and this also requires specialist equipment, explains Rimmer.

"The deck is formed of 91 precast planks, 2.5m long by 10m wide, and there is a very restricted construction sequence for the way the loads have to be introduced into the structure – they can't be locked in until the full weight of the deck is on the structure.

"We aren't permitted to work in the river and don't have cranes capable of reaching the centre of the bridge, so we developed a trolley system on which planks are driven across the bridge from the south side, and placed one at a time, working back from the north side across the bridge," he adds.

Plank installation was identified as a potential issue early in the process, so the superstructure was designed to accommodate a running track for the trolley along the centre of the flange.

Work is currently on schedule for the bridge to open to the public in August 2025. **N**